(19) Japan Patent Office (JP)

(12) **PUBLICATION OF UNEXAMINED PATENT APPLICATION** (A)

(11) Japanese Unexamined Patent Application Publication

No.: 2003-298346 (P2003-298346A)

(43) Date of publication: October 17, 2003

(51) Int.Cl.^{7}	Domestic Classification Symbol	FI	Theme code (reference)
H01Q 13/08		H01Q 13/08	5J045
1/36		1/36	5J045
5/01		5/01	

Request for Examination: Not Requested

Number of claims: 4 OL (total 7 pages)

(21) Application No.: P2002-103289

(22) Date of filing: April 5, 2002

(71) Applicant: 000005821

Matsushita Electric Industrial Co., Ltd.

1006, Oaza Kadoma, Kadoma City, Osaka, Japan

(72) Inventor: Masahiro OHARA

c/o Matsushita Electric Industrial Co., Ltd.

1006, Oaza Kadoma, Kadoma City, Osaka, Japan

(72) Inventor: Akio MIYAJIMA

c/o Matsushita Electric Industrial Co., Ltd.

1006, Oaza Kadoma, Kadoma City, Osaka, Japan

(74) Agent: 100097445

Fumio IWAHASHI, Patent Attorney (2 others)

F-term (reference)

5J045 AA01 AA03 AB05 DA09 GA04

HA02 JA11 NA03

5J046 AA03 AA07 AB13 PA04

(54) Title of the Invention: ANTENNA DEVICE

(57) [Abstract]

[Problem]

Providing an antenna device for a wireless device, e.g. a cell-phone, for mobile communication which has high sensitivity and whose impedance can be adjusted with ease.

[Solution]

An antenna device (19) includes a conductive ground plane (17) and a plate-like first antenna element (11) disposed above the conductive ground plane (17). The first antenna element (11) facing the conductive ground plane (17) includes an open end portion (12A) provided with a cut-away portion (22A) and an outer peripheral end portion (12B) provided with a cut-away portion (22B). In this configuration, the antenna capacitance can be largely changed, and the resonant frequency, resonant frequency band, and antenna impedance can be easily corrected. This makes it possible to flexibly position the antenna device (19) relative to the high-frequency circuit section without changing the shapes of its portions other than the open end

portion (12A) and the outer peripheral end portion (12B) while providing the antenna device (19) with high sensitivity.

[Scope of Claims]

[Claim 1] An antenna device comprising: a conductive ground plane, a plate-like first antenna element disposed above the conductive ground plane, a first terminal electrically connecting the first antenna element and the conductive ground plane, and a second terminal disposed spaced a predetermined distance from the first terminal and electrically connected to a high-frequency circuit section provided in a wireless device main body; wherein an area facing the conductive ground plane of the first antenna element is changed either by providing at least one of an open end portion or an outer peripheral end portion of the first antenna element and the conductive ground plane facing the first antenna element with a hole or a cut-away portion or by changing a positional relationship between the first antenna element and the conductive ground plane.

[Claim 2] The antenna device according to claim 1, wherein the first antenna element includes a plurality of radiating conductor portions with mutually different electrical lengths.

[Claim 3] An antenna device comprising: a conductive ground plane, a plate-like first antenna element disposed above the conductive ground plane, a first terminal electrically connecting the first antenna element and the conductive ground plane, a second terminal disposed spaced a

predetermined distance from the first terminal and electrically connected to a high-frequency circuit section provided in a wireless device main body, and a plate-like second antenna element disposed spaced a predetermined distance from the first antenna element; wherein an area facing the conductive ground plane of the first antenna element or the second antenna element is changed either by providing at least one of an open end portion or an outer peripheral end portion of the first antenna element or the second antenna element and the conductive ground plane facing the first antenna element and the second antenna element with a hole or a cut-away portion or by changing a positional relationship between the first antenna element or the second antenna element and the conductive ground plane.

[Claim 4] The antenna device according to claim 3, wherein at least one of the first antenna element and the second antenna element includes a plurality of radiating conductor portions with mutually different electrical lengths.

[Detailed Description of the Invention]

[0001]

[Industrial Application] The present invention relates to an antenna device used mainly for a wireless device for mobile communication, for example, a cell-phone.

[0002]

[Description of the Prior Art] In recent years, as the demand for wireless devices for mobile communications, for example, cell-phones increases, antenna devices which can be built into various designs of wireless devices have also been in increasing demand. Among such antenna devices, inverted-F antennas including a plate-like horizontal portion facing a conductive ground plane are widely used.

[0003] Such an existing type of an inverted-F antenna will be described with reference to FIG. 3 showing a perspective view of an essential part of the antenna.

[0004] Referring to FIG. 3, a plate-like antenna element 1 is made of copper alloy and has a depth L1 and a width L2. A plate-like conductive ground plane 2 made of copper alloy is disposed a distance H below and approximately in parallel with the antenna element 1. This configuration is fixed in a case (not shown) made of insulating resin.

[0005] In an antenna device 7 including the antenna element 1 and the conductive ground plane 2, a first terminal 3 formed in an end portion of the antenna element 1 is electrically connected to the conductive ground plane 2, for example, by soldering. A second terminal 5 is formed at a feed point 4 spaced a distance L4 from the first terminal 3. The second terminal 5 extends, being insulated from the conductive ground plane 2, through a hole 6 formed in the conductive ground plane 2 and projects below the conductive

ground plane 2.

[0006] The antenna device 7 is installed in a wireless device main body (not shown). The conductive ground plane 2 of the antenna device 7 is electrically connected to a ground portion (not shown) formed in the wireless device main body. The second terminal 5 of the antenna device 7 is electrically connected, for example, by crimping, to a high-frequency circuit section (not shown) provided in the wireless device main body.

[0007] In the wireless device configured as described above, when an electromagnetic wave of a predetermined resonant frequency is received, the antenna device 7 converts it into an electrical signal and inputs the electrical signal to the high-frequency circuit section provided in the wireless device main body via the second terminal 5. When an electrical signal of a predetermined resonant frequency is received for transmission from the high-frequency circuit section, the antenna device 7 converts the electrical signal into an electromagnetic wave and radiates the electromagnetic wave.

[0008] The dielectricity of the antenna device 7 is dependent on the length, i.e. distance H, of the first terminal 3 formed to extend from the antenna element 1 of the antenna device 7. The capacitance of the antenna device 7 is affected by other parts than the first terminal 3 of

the antenna element 1 as seen from the feed point 4. The resonant frequency of the antenna device 7 is determined by the dielectricity and capacitance.

[0009] When the depth L1 and width L2 of the antenna element 1 are increased to increase the capacitance or when the distance H between the antenna element 1 and the conductive ground plane 2 is increased to increase the dielectricity, the resonant frequency of the antenna device 7 is lowered. Conversely, when the depth L1 and width L2 of the antenna element 1 are decreased to decrease the capacitance or when the distance H between the antenna element 1 and the conductive ground plane 2 is decreased to decrease the dielectricity, the resonant frequency of the antenna device 7 is raised.

[0010] Therefore, the impedance of the antenna device 7 used to be determined by first determining the values of L1, L2, and H so as to obtain a predetermined resonant frequency and then determining the location of the feed point 4, i.e. the value of L4, so as to bring the impedance of the high-frequency circuit section provided in the wireless device main body as close as possible to a value which enables transmission and reception at the resonant frequency with the highest sensitivity.

[0011]

[Problem to be Solved by the Invention] When the antenna

device 7 that is an existing type of an antenna device is fitted to a wireless device main body, however, the effect of the electromagnetic field distribution on the antenna device 7 changes according to the position relative to the high-frequency circuit section of the antenna device 7. This may cause the antenna impedance to deviate from the predetermined value and the resonant frequency and resonant frequency band to change, making desired sensitivity unavailable for the antenna device 7. In reality, therefore, there has been a problem that a differently shaped antenna, for example, with different values of L1, L2, and H is required for every differently located high-frequency circuit section.

[0012] The present invention has been made in view of the above problem, and it is an object of the invention to provide a sensitive antenna device whose impedance can be adjusted with ease.

[0013]

[Means for Solving the Problem] To achieve the above object, the present invention is configured as follows.

[0014] The invention of claim 1 provides an antenna device in which an area facing a conductive ground plane of a plate-like first antenna element disposed above the conductive ground plane is changed either by providing at least one of an open end portion or outer peripheral end

portion of the first antenna element and the conductive ground plane facing the first antenna element with a hole or a cut-away portion or by changing a positional relationship between the first antenna element and the conductive ground plane. In the antenna device configured as described above, the electric field strength is large at the open end portion and the outer peripheral end portion of the first antenna element, and the open end portion and the outer peripheral end portion differ from each other in surface area facing the conductive ground plane. The antenna capacitance can therefore be changed with ease, and a resonant frequency, resonant frequency band, and antenna impedance can be easily corrected. This makes it possible to flexibly position the antenna device relative to the high-frequency circuit section without changing the shapes of its portions other than the open end portion and the outer peripheral end portion while providing the antenna device with high sensitivity.

[0015] The invention of claim 2 provides the antenna device according to the invention of claim 1, in which the first antenna element includes a plurality of radiating conductor portions with mutually different electrical lengths, so that the antenna device is made capable of transmission and reception in a plurality of frequency bands.

[0016] The invention of claim 3 provides an antenna device

in which, in addition to a plate-like first antenna element disposed above a conductive ground plane, a plate-like second antenna element is provided spaced a predetermined distance from the first antenna element and in which an area facing the conductive ground plane of the first antenna element or the second antenna element is changed either by providing at least one of an open end portion or an outer peripheral end portion of the first antenna element or the second antenna element and the conductive ground plane facing the first antenna element and the second antenna element with a hole or a cut-away portion or by changing a positional relationship between the first antenna element or the second antenna element and the conductive ground plane. This makes it possible to correct with ease a resonant frequency, resonant frequency band, and impedance of the antenna device and realize a wide frequency band, in which the wireless device can transmit and receive signals, by combining the resonant frequency bands of the first antenna element and the second antenna element.

[0017] The invention of claim 4 provides the antenna device according to the invention of claim 3, in which at least one of the first antenna element and the second antenna element includes a plurality of radiating conductor portions with mutually different electrical lengths, so

that the antenna device is made capable of transmission and reception in a plurality of frequency bands.

[0018]

[Best Mode for Carrying Out the Invention] Embodiments of the present invention will be described with reference to FIGS. 1 and 2.

[0019] (Embodiment 1) The inventions according to claims 1 and 2, in particular, will be described based on embodiment 1.

[0020] FIG. 1 is a perspective view of an essential part of an antenna device according to a first embodiment of the present invention. In FIG. 1, reference numeral 17 denotes a conductive ground plane which is made of a thin plate of conducting metal, for example, copper, copper alloy, aluminum alloy, or stainless alloy, or such a thin plate plated with conducting metal, for example, gold or nickel.

[0021] The conductive ground plane 17 is provided, at a predetermined part thereof, with a terminal (not shown) to be electrically connected to the ground side of a high-frequency circuit section provided in a wireless device main body (not shown).

[0022] Reference numeral 11 denotes a first antenna element disposed to extend a predetermined distance above and approximately in parallel with the conductive ground plane 17. The first antenna element 11 is, like the conductive

ground plane 17, made of a thin plate of conducting metal or such a thin plate plated with conducting metal.

[0023] The first antenna element 11 is provided, at a lower left end part thereof as seen in FIG. 1, with a first terminal 13 extending perpendicularly downwardly therefrom and being electrically connected to the conductive ground plane 17.

[0024] The first antenna element 11 is also provided with a second terminal 16 which is spaced a predetermined distance from the first terminal 13 and which extends perpendicularly downwardly therefrom to be electrically connected to a signal input/output side of the high-frequency circuit section provided in the wireless device main body.

[0025] The first antenna element 11 integrally includes a first radiating conductor portion 12 with a predetermined electrical length and a second radiating conductor portion 14 with an electrical length different from that of the first radiating conductor portion 12.

[0026] The first radiating conductor portion 12 of the first antenna element 11 includes an open end portion 12A having a cut-away portion 22A and an outer peripheral end portion 12B having a cut-away portion 22B, the cut-away portions 22A and 22B having been formed, for example, by cutting or punching.

[0027] The area facing the conductive ground plane 17 of each of the open end portion 12A and the outer peripheral end portion 12B is smaller than that of any comparable portion having no cut-away portion of the first radiating conductor portion 12.

[0028] The first antenna element 11 and the conductive ground plane 17 are fixed spaced a predetermined distance from each other in an insulated case (not shown) of ABS resin thereby making up an antenna device 19.

[0029] The dimensional settings of components of the antenna device 19 configured as described above will be described below.

[0030] First, the electrical length of the first radiating conductor portion 12 of the first antenna element 11 and the distance between the first antenna element 11 and the conductive ground plane 17 are set such that a resonant frequency can be obtained in a predetermined frequency band, for example, 890 to 925 MHz.

[0031] In doing this, enlarging the cut-away portions 22A and 22B decreases the area facing the conductive ground plane 17 of each of the open end portion 12A and the outer peripheral end portion 12B causing the capacitance of the first radiating conductor portion 12 to decrease and the resonant frequency to rise.

[0032] Next, the electrical length of the second radiating

conductor portion 14 of the first antenna element 11 and the distance between the first antenna element 11 and the conductive ground plane 17 are set such that a resonant frequency can be obtained in another predetermined frequency band, for example, 1710 to 1880 MHz.

[0033] Thus, two resonant frequency bands usable for transmission and reception are set in the wireless device, i.e. a resonant frequency band of 890 to 925 MHz based on the first radiating conductor portion 12 with a predetermined electrical length and another resonant frequency band of 1710 to 1880 MHz based on the second radiating conductor portion 14 with another predetermined electrical length.

[0034] Subsequently, the impedance of the antenna is determined. This is done by setting the position of the second terminal 16 so as to bring the impedance of the high-frequency circuit section provided in the wireless device main body as close as possible to a value, usually about 50 ohms, which enables transmission and reception with the highest sensitivity at the resonant frequencies.

[0035] When the antenna device 19 is fitted to the wireless device main body, however, the effect of the electromagnetic field distribution on the antenna device 19 changes according to the position relative to the high-frequency circuit section of the antenna device 19. This

possibly causes the antenna impedance to deviate from the predetermined value and the resonant frequencies and resonant frequency bands to change, making desired sensitivity unavailable for the antenna device 19.

[0036] To cope with the above problem, the antenna device 19 is configured such that, in cases where the impedance of the antenna device 19 fitted, after the position in the wireless device main body of the high-frequency circuit section is fixed, to a predetermined part of the wireless device main body has deviated from a predetermined value, the impedance can be corrected by changing the areas of the cut-away portions 22A and 22B of the open end portion 12A and the outer peripheral end portion 12B, respectively, of the first radiating conductor portion 12 to a value which enables transmission and reception with the highest sensitivity.

[0037] As is known from electromagnetism, the field strength of electromagnetic radiation is large at the open end portion 12A and the outer peripheral end portion 12B that is positioned away from the second terminal 16, so that changing the area of the cut-away portion 22A of the open end portion 12A or the area of the cut-away portion 22B of the outer peripheral end portion 12B can largely change the antenna capacitance. Namely, the antenna impedance can be efficiently adjusted.

[0038] When an electromagnetic wave of a predetermined resonant frequency is received, the antenna device 19 configured as described above converts the electromagnetic wave into an electrical signal and inputs the electrical signal to the high-frequency circuit section provided in the wireless device main body via the second terminal 16. When an electrical signal of the predetermined resonant frequency is received for transmission from the high-frequency circuit section, the antenna device 19 converts the electrical signal into an electromagnetic wave and radiates the electromagnetic wave.

[0039] As described above, according to the first embodiment, the plate-like first antenna element 11 disposed above the conductive ground plane 17 includes the open end portion 12A and the outer peripheral end portion 12B each facing the conductive ground plane 17. The open end portion 12A and the outer peripheral end portion 12B have the cut-away portions 22A and 22B, respectively. In the antenna device 19 configured as described above, the electric field strength is large at the open end portion 12A and the outer peripheral end portion 12B of the first antenna element 11, and the open end portion 12A and the outer peripheral end portion 12B differ from each other in surface area facing the conductive ground plane 17. The antenna capacitance can therefore be largely changed, and

the resonant frequencies, resonant frequency bands, and antenna impedance can be easily corrected. This makes it possible to flexibly position the antenna device 19 relative to the high-frequency circuit section without changing the shapes of its portions other than the open end portion 12A and the outer peripheral end portion 12B while providing the antenna device 19 with high sensitivity.

[0040] The first antenna element 11 includes the first radiating conductor portion 12 with a predetermined electrical length and the second radiating conductor portion 14 with another electrical length, so that the antenna device 19 can be made capable of transmission and reception in two different resonant frequency bands of the wireless device.

[0041] Furthermore, employing a configuration in which a conductive ground plane connected to the first antenna element 11 is formed on a wiring substrate on which a high-frequency circuit section is formed in the wireless device main body can reduce the number of components of the antenna device as a whole and facilitate making the wireless device main body smaller.

[0042] Even though it has been explained above that the antenna impedance is corrected by providing the open end portion 12A and outer peripheral end portion 12B, both facing the conductive ground plane 17, of the first

radiating conductor portion 12 with the cut-away portions 22A and 22B, respectively, the invention can be implemented also by providing either one of the open end portion 12A and outer peripheral end portion 12B of the first radiating conductor portion 12 with a cut-away portion to correct the antenna impedance.

[0043] The antenna impedance may also be corrected by providing not the first radiating conductor portion 12 but an open end portion 14A and outer peripheral end portion 14B of the second radiating conductor portion 14 with cut-away portions, or by providing both the first radiating conductor portion 12 and the second radiating conductor portion 14 with cut-away portions.

[0044] Furthermore, the antenna impedance may also be corrected by forming not cut-away portions but holes in the first antenna element 11 and conductive ground plane 17, or by shifting either the first antenna element 11 facing the conductive ground plane 17 or the conductive ground plane 17 in the front-rear or left-right direction and thereby changing the positions relative to the conductive ground plane 17 of the open end portions 12A and 14A and outer peripheral end portions 12B and 14B of the first antenna element 11.

[0045] Even though it has been explained above that the first antenna element 11 and the conductive ground plane 17

are each made of a thin plate of conducting metal, for example, copper or copper alloy, or such a thin plate plated with conducting metal, for example, gold or nickel, the first antenna element 11 and the conductive ground plane 17 may be each made of resin which is covered with conducting metal, for example, copper or copper alloy formed by, for example, plating or printing, or which is covered with a film of conducting metal, for example, copper or copper alloy applied thereto.

[0046] (Embodiment 2) The inventions according to claims 3 and 4, in particular, will be described based on embodiment 2.

[0047] Between embodiments 1 and 2, like components are assigned like reference numerals, and such like components will not be described in detail for embodiment 2.

[0048] FIG. 2 is a perspective view of an essential part of an antenna device according to a second embodiment of the present invention. In FIG. 2, reference numeral 17 denotes a conductive ground plane which is made of a thin plate of conducting metal or such a thin plate plated with conducting metal.

[0049] The conductive ground plane 17 is provided, at a predetermined part thereof, with a terminal (not shown) to be electrically connected to the ground side of a high-frequency circuit section provided in a wireless device

main body (not shown).

[0050] Reference numeral 11 denotes a first antenna element disposed to extend a predetermined distance above and approximately in parallel with the conductive ground plane 17. The first antenna element 11 is made of a thin plate of conducting metal or such a thin plate plated with conducting metal.

[0051] The first antenna element 11 is provided, at a lower left end part thereof as seen in FIG. 2, with a first terminal 13 extending perpendicularly downwardly therefrom and being electrically connected to the conductive ground plane 17. The first antenna element 11 is also provided with a second terminal 16 which is spaced a predetermined distance from the first terminal 13 and which extends perpendicularly downwardly therefrom to be electrically connected to the signal input/output side of the high-frequency circuit section provided in the wireless device main body.

[0052] The first antenna element 11 integrally includes a first radiating conductor portion 12 with a predetermined electrical length and a second radiating conductor portion 14 with another electrical length different from that of the first radiating conductor portion 12.

[0053] Reference numeral 18 denotes a second antenna element disposed between the first antenna element 11 and

the conductive ground plane 17 without being directly connected to either of them. The second antenna element 18 is predetermined distances spaced from the first antenna element 11 and the conductive ground plane 17, respectively, to be approximately in parallel with them. The second antenna element 18 is, like the first antenna element 11 and the conductive ground plane 17, made of a thin plate of conducting metal or such a thin plate plated with conducting metal.

[0054] The second antenna element 18 includes a radiating conductor portion with a predetermined electrical length. The radiating conductor portion includes an open end portion 18A having a cut-away portion 28A and an outer peripheral end portion 18B having a cut-away portion 28B, the cut-away portions 28A and 28B having been formed, for example, by cutting or punching.

[0055] The first antenna element 11, the conductive ground plane 17, and the second antenna element 18 are fixed spaced from one another in an insulated case (not shown) of ABS resin thereby making up an antenna device 29.

[0056] The dimensional settings of components of the antenna device 29 configured as described above will be described below.

[0057] First, the electrical length of the first radiating conductor portion 12 of the first antenna element 11 and

the distance between the first antenna element 11 and the conductive ground plane 17 are set such that a resonant frequency can be obtained in a predetermined frequency band, for example, 890 to 925 MHz.

[0058] Next, the electrical length of the radiating conductor portion of the second antenna element 18 and the distance between the second antenna element 18 and the conductive ground plane 17 are set such that a resonant frequency can be obtained in a frequency band, for example, 925 to 960 MHz, on the higher side of the predetermined resonant frequency band.

[0059] In doing this, enlarging the cut-away portions 28A and 28B decreases the capacitance of the second antenna element 18 and causes the resonant frequency to rise.

[0060] The resonant frequency band of 890 to 925 MHz of the first antenna element 11 and the resonant frequency band of 925 to 960 MHz of the second antenna element 18 are combined realizing a wider predetermined resonant frequency band of 890 to 960 MHz in which the wireless device can transmit and receive signals.

[0061] Furthermore, the electrical length of the second radiating conductor portion 14 of the first antenna element 11 and the distance between the first antenna element 11 and the conductive ground plane 17 are set such that a resonant frequency can be obtained in another predetermined

resonant frequency band, for example, 1710 to 1880 MHz.

[0062] Thus, two resonant frequency bands usable for transmission and reception are set in the wireless device. One is the resonant frequency band of 890 to 960 MHz realized by combining the resonant frequency band of 890 to 925 MHz based on the first radiating conductor portion 12 with a predetermined electrical length of the first antenna element 11 and the resonant frequency band of 925 to 960 MHz based on the radiating conductor portion with another electrical length, which is different from that of the first radiating conductor portion 12, of the second antenna element 18. The other is the resonant frequency band of 1710 to 1880 MHz based on the second radiating conductor portion 14 with still another electrical length, which is different from the above two, of the first antenna element 11.

[0063] Subsequently, the impedance of the antenna is determined. This is done by setting the position of the second terminal 16 so as to bring the impedance of the high-frequency circuit section in the wireless device main body as close as possible to a value, usually about 50 ohms, which enables transmission and reception with the highest sensitivity at the resonant frequencies.

[0064] When the antenna device 29 is fitted to the wireless device main body, however, the effect of the

electromagnetic field distribution on the antenna device 29 changes according to the position relative to the high-frequency circuit section of the antenna device 29. This possibly causes the antenna impedance to deviate from the predetermined value and the resonant frequencies and resonant frequency bands to change, making desired sensitivity unavailable for the antenna device 29.

[0065] To cope with the above problem, the antenna device 29 is configured such that, in cases where the impedance of the antenna device 29 fitted, after the high-frequency circuit section is fixed in the wireless device main body, to a predetermined part of the wireless device main body has deviated from the predetermined value, the impedance can be corrected by changing the areas of the cut-away portions 28A and 28B of the open end portion 18A and outer peripheral end portion 18B, respectively, of the second antenna element 18 so as to enable transmission and reception with the highest sensitivity.

[0066] When an electromagnetic wave of a predetermined resonant frequency is received, the antenna device 29 configured as described above converts the electromagnetic wave into an electrical signal and inputs the electrical signal to the high-frequency circuit section provided in the wireless device main body via the second terminal 16. When an electrical signal of a predetermined resonant

frequency is received for transmission from the high-frequency circuit section, the antenna device 29 converts the electrical signal into an electromagnetic wave and radiates the electromagnetic wave.

[0067] As described above, according to the second embodiment, in addition to the plate-like first antenna element 11 disposed above the conductive ground plane 17, the plate-like second antenna element 18 is provided spaced a predetermined distance from the first antenna element 11. The second antenna element 18 includes the open end portion 18A and outer peripheral end portion 18B facing the conductive ground plane 17 and having the cut-away portions 28A and 28B, respectively. This makes it possible to correct with ease the resonant frequencies, resonant frequency bands, and impedance of the antenna device and provide the antenna device with high sensitivity. In addition, the antenna device allows the wireless device to transmit and receive signals in a wide resonant frequency band realized by combining the resonant frequency bands of the first antenna element 11 and the second antenna element 18.

[0068] Furthermore, providing at least either one of the first antenna element 11 and the second antenna element 18 with two or more radiating conductor portions with mutually differing electrical lengths makes the antenna device

capable of transmission and reception in two or more frequency bands.

[0069] Even though it has been explained above that the antenna impedance can be corrected by providing the open end portion 18A and the outer peripheral end portion 18B, both facing the conductive ground plane 17, of the second antenna element 18 with the cut-away portions 28A and 28B, respectively, the invention can be implemented also by providing either one of the open end portion 18A and outer peripheral end portion 18B of the second antenna element 18 with a cut-away portion to correct the antenna impedance.

[0070] The antenna impedance may also be corrected by providing the open end portion 12A and outer peripheral end portion 12B of the first radiating conductor portion 12 of the first antenna element 11 or the open end portion 14A and outer peripheral end portion 14B of the second radiating conductor portion 14 of the first antenna element 11 with cut-away portions, or by providing both the first antenna element 11 and the second antenna element 18 both facing the conductive ground plane 17 with cut-away portions.

[0071] Furthermore, the antenna impedance may also be corrected by forming not cut-away portions but holes in the first antenna element 11, the second antenna element 18, and the conductive ground plane 17, or by shifting the

first antenna element 11, the second antenna element 18, or the conductive ground plane 17 in the front-rear or left-right direction and thereby changing the positions relative to the conductive ground plane 17 of the open end portions 12A and 14A and outer peripheral end portions 12B and 14B of the first antenna element 11 or the open end portion 18A and outer peripheral end portion 18B of the second antenna element 18.

[0072] Even though it has been explained above that, with the first antenna element 11 provided with the second radiating conductor portion 14 having a predetermined resonant frequency different from that of the first radiating conductor portion 12, the antenna device is capable of transmission and reception with required sensitivity in two different resonant frequency bands for the wireless device, the same effect may be achieved by providing the second antenna element 18 with a radiating conductor portion without providing the first antenna element 11 with the second radiating conductor portion 14.

[0073] Even though, in the second embodiment, the second antenna element 18 is disposed between the first antenna element 11 and the conductive ground plane 17, the second antenna element 18 may be disposed above or to a side of the first antenna element 11.

[0074] Even though, in the second embodiment, the second

antenna element 18 facing the conductive ground plane 17 is provided with the cut-away portions 28A and 28B, the first antenna element 11 also facing the conductive ground plane 17 may be provided with such cut-away portions, or the first antenna element 11 and the second antenna element 18 may both be provided with such cut-away portions.

[0075]

[Effect of the Invention] As described above, the present invention can produce advantageous effects which can make available a sensitive antenna device whose impedance can be adjusted with ease.

[Brief Description of the Drawings]

FIG. 1 is a perspective view of an essential part of an antenna device according to a first embodiment of the present invention.

FIG. 2 is a perspective view of an essential part of an antenna device according to a second embodiment of the present invention.

FIG. 3 is a perspective view of an essential part of an existing type of an antenna device.

[Description of Reference Numerals]

11 First antenna element

12 First radiating conductor portion

12A, 14A, 18A Open end portion

12B, 14B, 18B Outer peripheral end portion

13 First terminal

14 Second radiating conductor portion

16 Second terminal

17 Conductive ground plane

18 Second antenna element

19, 29 Antenna device

22A, 22B, 28A, 28B Cut-away portion

[Drawing]

FIG. 1

11 First antenna element

12 First radiating conductor portion

12A, 14A Open end portion

12B Outer peripheral end portion

13 First terminal

14 Second radiating conductor portion

16 Second terminal

17 Conductive ground plane

19 Antenna device

22A, 22B Cut-away portion

(19)日本国特許庁（ＪＰ）　　(12) 公開特許公報（Ａ）　　(11)特許出願公開番号

特開2003－298346

（P2003－298346A）

(43)公開日　平成15年10月17日(2003.10.17)

(51)Int.Cl.⁷	識別記号	ＦＩ	テーマコード゛(参考)
Ｈ０１Ｑ　13/08		Ｈ０１Ｑ　13/08	５Ｊ０４５
1/36		1/36	５Ｊ０４６
5/01		5/01	

審査請求　未請求　請求項の数４　　ＯＬ　（全　７　頁）

(21)出願番号　特願2002－103289(P2002－103289)

(22)出願日　平成14年４月５日(2002.4.5)

(71)出願人　000005821
松下電器産業株式会社
大阪府門真市大字門真1006番地

(72)発明者　大原　正廣
大阪府門真市大字門真1006番地　松下電器産業株式会社内

(72)発明者　宮嶋　明雄
大阪府門真市大字門真1006番地　松下電器産業株式会社内

(74)代理人　100097445
弁理士　岩橋　文雄　（外２名）

最終頁に続く

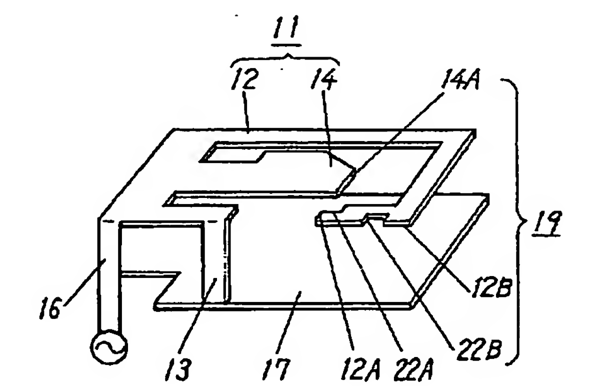
(54)【発明の名称】　アンテナ装置

(57)【要約】

【課題】　携帯電話等の移動体通信用の無線装置に使用されるアンテナ装置に関し、インピーダンスの調整が容易で、感度の良好なアンテナ装置を提供することを目的とする。

【解決手段】　導体地板１７上に配設された板状の第１アンテナ素子１１の開放端部１２Ａ及び外周端部１２Ｂと導体地板１７端部間に各々、切欠き部２２Ａ及び２２Ｂを設けてアンテナ装置１９を構成することによって、大きく容量性を変化させることができ、共振周波数及びその帯域やインピーダンスを容易に補正して、開放端部又は外周端部以外の形状は同一で高周波回路部との様々な配置に対応できる、感度の良好なアンテナ装置を得ることができる。

11　第１アンテナ素子
12　第１放射導体部
12A,14A　開放端部
12B　外周端部
13　第１端子
14　第２放射導体部
16　第２端子
17　導体地板
19　アンテナ装置
22A,22B　切欠き部



【特許請求の範囲】
【請求項１】　導体地板と、この導体地板上に配設された板状の第１アンテナ素子と、この第１アンテナ素子と導体地板とを電気的に接続する第１端子と、この第１端子から所定距離を隔てて配置されると共に無線装置本体の高周波回路部に電気的に接続される第２端子からなり、前記第１アンテナ素子の開放端部又は外周端部、或いはこれらと対向する前記導体地板の少なくとも一つに孔又は切欠きを形成、或いは上下相対位置を変えて、これらの対向する面積を異なるものとしたアンテナ装置。
【請求項２】　第１アンテナ素子を電気長の異なる複数の放射導体部で形成した請求項１記載のアンテナ装置。
【請求項３】　導体地板と、この導体地板上に配設された板状の第１アンテナ素子と、この第１アンテナ素子と導体地板とを電気的に接続する第１端子と、この第１端子から所定距離を隔てて配置されると共に無線装置本体の高周波回路部に電気的に接続される第２端子と、前記第１アンテナ素子の近傍に所定の間隙を空けて設けられた板状の第２アンテナ素子からなり、前記第１アンテナ素子又は前記第２アンテナ素子の開放端部又は外周端部、或いはこれらと対向する前記導体地板の箇所の少なくとも一つに孔又は切欠きを形成、或いは上下相対位置を変えて、これらの対向する面積を異なるものとしたアンテナ装置。
【請求項４】　第１アンテナ素子又は第２アンテナ素子の少なくとも一方を電気長の異なる複数の放射導体部で形成した請求項３記載のアンテナ装置。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、主として携帯電話等の移動体通信用の無線装置に使用されるアンテナ装置に関するものである。
【０００２】
【従来の技術】近年、携帯電話等の移動体通信用の無線装置に対する需要の高まりと共に、様々なデザインの無線装置に対応できる内蔵用のアンテナ装置も同様に要望されており、そのアンテナ装置として、導体地板に対する水平部分を板状にした、いわゆる板状逆Ｆアンテナ装置が一般に広く使用されている。
【０００３】このような従来のアンテナ装置について、図３の要部斜視図を用いて説明する。
【０００４】同図において、銅合金板製の縦寸法Ｌ１×横寸法Ｌ２の大きさのアンテナ素子１の下方には、アンテナ素子１と間隔Ｈを保って銅合金板製の導体地板２が平行に配置され、図示していないが、絶縁樹脂でケースを形成し、このケースによってアンテナ素子１が間隔Ｈを空けて導体地板２に固定されている。
【０００５】そして、アンテナ素子１の一端に形成された第１端子３が導体地板２と半田付け等の方法で電気的に接続されると共に、アンテナ素子１の第１端子３から距離Ｌ４の位置の給電点４に第２端子５が形成され、導体地板２とは絶縁状態で孔６を貫通して導体地板２下方に突出してアンテナ装置７が構成されている。
【０００６】また、このアンテナ装置７は無線装置本体（図示せず）内に配設され、アンテナ装置７の導体地板２が無線装置本体内に形成されたグランド部（図示せず）に電気的に接続されると共に、アンテナ装置７の第２端子５が無線装置本体内に配設された高周波回路部（図示せず）に圧接等の方法により電気的に接続されている。
【０００７】以上の構成において、アンテナ装置７は、受信時には受信した所定の共振周波数の電磁波を電気信号に変換し、この電気信号を第２端子５を通して無線装置本体の高周波回路部へ入力し、送信時には逆に高周波回路部からの所定の共振周波数の電気信号を電磁波に変換し、電磁波として放射するように構成されている。
【０００８】また、アンテナ装置７のアンテナ素子１に形成された第１端子３の長さ、つまり間隔Ｈによって誘導性が、第１端子３部分を除くアンテナ素子１の給電点４から見た他の部分によって容量性が形成され、これらによってアンテナ装置７としての共振周波数が定められる。
【０００９】そして、アンテナ素子１の寸法Ｌ１，Ｌ２が大きくなって容量性が増したり、アンテナ素子１と導体地板２との間隔Ｈが大きくなって誘導性が増したりすると共振周波数は低くなり、逆にアンテナ素子１の寸法Ｌ１，Ｌ２が小さくなって容量性が減ったり、アンテナ素子１と導体地板２との間隔Ｈが小さくなって誘導性が減ったりすると共振周波数は高くなる。
【００１０】従って、所定の共振周波数が得られるようにＬ１，Ｌ２，Ｈを決定した後、この共振周波数に対応した最も感度良く送受信可能な無線装置本体の高周波回路部のインピーダンスに近づけるように、給電点４の位置、すなわちＬ４を設定することによってアンテナのインピーダンスを決定して、アンテナ装置７は構成されるものであった。
【００１１】
【発明が解決しようとする課題】しかしながら、上記従来のアンテナ装置７においては、アンテナ装置７を無線装置本体に装着した場合、高周波回路部との配置によっては、アンテナ装置７と高周波回路部の相対位置の違いに伴う電磁界分布の変化の影響を受け、インピーダンスが所定の値から変化し、共振周波数及びその帯域が変化して所望の感度が得られないため、実際には高周波回路部の配置に合わせ都度Ｌ１，Ｌ２，Ｈ等の形状の異なるアンテナが必要となるという課題があった。
【００１２】本発明はこのような従来の課題を解決するものであり、インピーダンスの調整が容易で、感度の良好なアンテナ装置を提供することを目的とする。
【００１３】

【課題を解決するための手段】上記目的を達成するために本発明は、以下の構成を有するものである。

【００１４】本発明の請求項１に記載の発明は、導体地板上に配設された板状の第１アンテナ素子の開放端部又は外周端部、或いはこれらと対向する導体地板の少なくとも一つに孔又は切欠きを形成、或いは上下相対位置を変え、これらの対向する面積を異ならせてアンテナ装置を構成したものであり、電界が大きくなる開放端部又は外周端部で第１アンテナ素子と導体地板間の対面する面積が異なるため、大きく容量性を変化させることができ、共振周波数及びその帯域やインピーダンスを容易に補正して、開放端部又は外周端部以外の形状は同一で高周波回路部との様々な配置に対応できる、感度の良好なアンテナ装置を得ることができるという作用を有する。

【００１５】請求項２に記載の発明は、請求項１記載の発明において、第１アンテナ素子を電気長の異なる複数の放射導体部で形成したものであり、複数の帯域での送受信が可能なアンテナ装置を提供できるという作用を有する。

【００１６】請求項３に記載の発明は、導体地板上に板状の第１アンテナ素子を設けると共に、第１アンテナ素子の近傍に所定の間隙を空けて板状の第２アンテナ素子を設け、第１アンテナ素子又は第２アンテナ素子の開放端部又は外周端部、或いはこれらと対向する導体地板の少なくとも一つに孔又は切欠きを形成、或いは上下相対位置を変え、これらの対向する面積を異ならせてアンテナ装置を構成したものであり、共振周波数及びその帯域やインピーダンスを容易に補正できると共に、第１アンテナ素子の共振周波数の帯域と第２アンテナ素子の共振周波数の帯域とを合わせて無線装置の送受信可能な帯域を広帯域化することができるという作用を有する。

【００１７】請求項４に記載の発明は、請求項３記載の発明において、第１アンテナ素子又は第２アンテナ素子の少なくとも一方を電気長の異なる複数の放射導体部で形成したものであり、複数の帯域での送受信が可能なアンテナ装置を提供できるという作用を有する。

【００１８】

【発明の実施の形態】以下、本発明の実施の形態について、図１及び図２を用いて説明する。

【００１９】（実施の形態１）実施の形態１を用いて、本発明の特に請求項１及び２記載の発明について説明する。

【００２０】図１は本発明の第１の実施の形態によるアンテナ装置の要部斜視図であり、同図において、１７は導体地板で、銅、銅合金、アルミ合金、ステンレス合金等の導電金属或いはこれらにＡｕ，Ｎｉ等の導電性金属メッキを施した薄板状導体から形成されている。

【００２１】そして、この導体地板１７の所定の箇所には無線装置本体（図示せず）の高周波回路部のグランド側に電気的に接続される端子（図示せず）が設けられている。

【００２２】また、１１は第１アンテナ素子で、導体地板１７上に所定の間隔を保って略平行になるように配設され、導体地板１７と同様に、導電金属或いはこれに導電性金属メッキを施した薄板状導体から形成されている。

【００２３】そして、この第１アンテナ素子１１左下部の一端に導体地板１７に電気的に接続される第１端子１３が垂直下方に形成されている。

【００２４】また、この第１端子１３から所定の距離離れた位置に無線装置本体の高周波回路部の信号入出力側に電気的に接続される第２端子１６が垂直下方に形成されている。

【００２５】そして、この第１アンテナ素子１１には所定の電気長の第１放射導体部１２とこの電気長とは異なる電気長の第２放射導体部１４が一体に形成されている。

【００２６】また、この第１アンテナ素子１１の第１放射導体部１２には開放端部１２Ａに切欠き部２２Ａが、また外周端部１２Ｂには切欠き部２２Ｂが、各々切削や打抜き等によって設けられている。

【００２７】従って、開放端部１２Ａ及び外周端部１２Ｂと導体地板１７端部間の対向する面積は、第１放射導体部１２の他の箇所に比べ小さくなっている。

【００２８】そして、これらの第１アンテナ素子１１と導体地板１７は、一定の間隔を空け、ＡＢＳ樹脂からなる絶縁ケース（図示せず）で固定されて、アンテナ装置１９が構成されている。

【００２９】次に、以上のような構成のアンテナ装置１９の各寸法の設定について説明する。

【００３０】先ず、所定の共振周波数の帯域、例えば８９０～９２５ＭＨｚに共振周波数が得られるように第１アンテナ素子１１の第１放射導体部１２の電気長と、第１アンテナ素子１１と導体地板１７との間隔を設定する。

【００３１】なお、この時、切欠き部２２Ａ及び２２Ｂの面積を大きくすると、開放端部１２Ａ及び外周端部１２Ｂと導体地板１７端部間の対向する面積が減少し、容量性が減るため、共振周波数は高くなる。

【００３２】そして、前記とは異なる所定の共振周波数の帯域、例えば１７１０～１８８０ＭＨｚに共振周波数が得られるように第１アンテナ素子１１の第２放射導体部１４の電気長と、第１アンテナ素子１１と導体地板１７との間隔を設定する。

【００３３】従って、第１アンテナ素子１１の電気長の第１放射導体部１２による共振周波数の帯域８９０～９２５ＭＨｚと、この電気長とは異なる電気長の第２放射導体部１４による共振周波数の帯域１７１０～１８８０ＭＨｚの２つの送受信可能な帯域が無線装置には設定されている。

【００３４】そして、その後、これらの共振周波数に対応した最も感度良く送受信可能な無線装置本体の高周波回路部のインピーダンス、通常は約５０Ωに近づけるように、第２端子１６の位置を設定することによってアンテナのインピーダンスを決定している。
【００３５】しかし、アンテナ装置１９を無線装置本体に装着した場合、高周波回路部との配置によっては、アンテナ装置１９と高周波回路部の相対位置の違いに伴う電磁界分布の変化の影響を受け、インピーダンスが所定の値から変化し、共振周波数及びその帯域が変化して所望の感度が得られないことがある。
【００３６】従って、高周波回路部の配置が決定された後に、アンテナ装置１９を無線装置本体の所定位置に組み込み、インピーダンスが所定の値から変化している場合はこのインピーダンスを、第１放射導体部１２の開放端部１２Ａの切欠き部２２Ａ及び外周端部１２Ｂの切欠き部２２Ｂの面積を変えることで補正して、最も感度良く送受信可能なインピーダンスになるように構成されている。
【００３７】なお、電磁波の電界強度は電磁気学上、開放端部１２Ａや第２端子１６から離れている外周端部１２Ｂが大きいため、開放端部１２Ａ及び外周端部１２Ｂに設けた切欠き部２２Ａ又は２２Ｂの面積を変えることで大きく容量性を変化させることができ、インピーダンスを効率良く調整できる。
【００３８】以上の構成において、アンテナ装置１９は、受信時には受信した所定の共振周波数の電磁波を電気信号に変換し、この電気信号を第２端子１６を通して無線装置本体の高周波回路部へ入力し、送信時には逆に高周波回路部からの所定の共振周波数の電気信号を電磁波に変換し、電磁波として放射するように構成されている。
【００３９】このように本実施の形態によれば、導体地板１７上に配設された板状の第１アンテナ素子１１の開放端部１２Ａ及び外周端部１２Ｂと導体地板１７端部間に各々、切欠き部２２Ａ及び２２Ｂを設けてアンテナ装置１９を構成することによって、電界が大きくなる開放端部１２Ａ及び外周端部１２Ｂで第１アンテナ素子１１と導体地板１７端部間の対向する面積が異なるため、大きく容量性を変化させることができ、共振周波数及びその帯域やインピーダンスを容易に補正して、開放端部及び外周端部以外の形状は同一で高周波回路部との様々な配置に対応できる、感度の良好なアンテナ装置を得ることができるものである。
【００４０】また、第１アンテナ素子１１を所定の電気長の第１放射導体部１２とこの電気長とは異なる電気長の第２放射導体部１４とで形成することによって、２つの異なる無線装置の共振周波数の帯域での送受信が可能なアンテナ装置１９を得ることができる。
【００４１】さらに、導体地板を無線装置本体の高周波回路部等が形成された配線基板等に形成し、これに第１アンテナ素子１１を接続するように構成すれば、アンテナ装置全体としての構成部品数を減らし、無線装置本体の小型化を図ることができる。
【００４２】なお、以上の説明ではアンテナのインピーダンスを、第１放射導体部１２の開放端部１２Ａ及び外周端部１２Ｂの両方と導体地板１７端部間に、切欠き部２２Ａ及び２２Ｂを設けて補正するものとして説明したが、第１放射導体部１２の開放端部１２Ａ又は外周端部１２Ｂのどちらか一方と導体地板１７間に切欠き部を設けてインピーダンスを補正しても本発明の実施は可能である。
【００４３】或いは、第１放射導体部１２に代えて第２放射導体部１４の開放端部１４Ａや外周端部１４Ｂと導体地板１７間に切欠き部を設けたり、第１放射導体部１２にも第２放射導体部１４にも切欠き部を設けてインピーダンスの補正を行っても良い。
【００４４】さらに、第１アンテナ素子１１や導体地板１７に切欠き部を設ける代りに孔を設けたり、第１アンテナ素子１１の開放端部１２Ａ，１４Ａや外周端部１２Ｂ，１４Ｂの端部とこれらと対向する導体地板１７の端部の上下相対位置を第１アンテナ素子１１又は導体地板１７を前後左右にずらすことでインピーダンスの補正を行っても良い。
【００４５】そして、第１アンテナ素子１１や導体地板１７を銅、銅合金等の導電金属或いはこれらにＡｕ，Ｎｉ等の導電性金属メッキを施した薄板状導体で形成されたものとして説明したが、第１アンテナ素子１１や導体地板１７を樹脂で構成された表面にメッキや印刷等によって銅、銅合金等の導電金属を形成したものや、或いは銅、銅合金等の導電金属を形成したフィルムを樹脂に貼りつけても良い。
【００４６】（実施の形態２）実施の形態２を用いて、本発明の特に請求項３及び４記載の発明について説明する。
【００４７】なお、実施の形態１の構成と同一構成の部分には同一符号を付して、詳細な説明を省略する。
【００４８】図２は本発明の第２の実施の形態によるアンテナ装置の要部斜視図であり、同図において、１７は導体地板であり、導電金属或いはこれに導電性金属メッキを施した薄板状導体から形成されている。
【００４９】そして、この導体地板１７の所定の箇所には無線装置本体（図示せず）の高周波回路部のグランド側に電気的に接続される端子（図示せず）が設けられている。
【００５０】また、１１は第１アンテナ素子であり、導体地板１７上に所定の間隔を保って略平行になるように配設され、導電金属或いはこれに導電性金属メッキを施した薄板状導体から形成されている。
【００５１】そして、この第１アンテナ素子１１左下部

の一端に導体地板１７に電気的に接続される第１端子１３が垂直下方に形成されると共に、この第１端子１３から所定の距離離れた位置に無線装置本体の高周波回路部の信号入出力側に電気的に接続される第２端子１６が垂直下方に形成されている。

【００５２】そして、この第１アンテナ素子１１には所定の電気長の第１放射導体部１２とこの電気長とは異なる電気長の第２放射導体部１４が一体に形成されている。

【００５３】また、１８は第２アンテナ素子であり、第１アンテナ素子１１及び導体地板１７の間にそれらと直接接続されないで略平行になるように所定の間隔を保って配設され、第１アンテナ素子１１及び導体地板１７と同様に、導電金属或いはこれに導電性金属メッキを施した薄板状導体で形成されている。

【００５４】そして、この第２アンテナ素子１８は所定の電気長の一つの放射導体部から形成されており、この第２アンテナ素子１８の開放端部１８Ａには切欠き部２８Ａが、また外周端部１８Ｂには切欠き部２８Ｂが、各々切削や打抜き等によって設けられている。

【００５５】また、これらの第１アンテナ素子１１、導体地板１７及び第２アンテナ素子１８は、それぞれ第１アンテナ素子１１と導体地板１７との間隔、第２アンテナ素子１８と導体地板１７との間隔を空け、ＡＢＳ樹脂からなる絶縁ケース（図示せず）で固定されて、アンテナ装置２９が構成されている。

【００５６】次に、以上のような構成のアンテナ装置２９の各寸法の設定について説明する。

【００５７】先ず、所定の共振周波数の帯域、例えば８９０～９２５ＭＨｚに共振周波数が得られるように第１アンテナ素子１１の第１放射導体部１２の電気長と、第１アンテナ素子１１と導体地板１７との間隔を設定する。

【００５８】次に、所定の共振周波数の帯域の高域側、例えば９２５～９６０ＭＨｚに共振周波数が得られるように第２アンテナ素子１８の放射導体部の電気長と、第２アンテナ素子１８と導体地板１７との間隔を設定する。

【００５９】なおこの時、切欠き部２８Ａ及び２８Ｂの面積を大きくすると、容量性が減り、共振周波数は高くなる。

【００６０】つまり、これら第１アンテナ素子１１の共振周波数の帯域８９０～９２５ＭＨｚと、第２アンテナ素子１８の共振周波数の帯域９２５～９６０ＭＨｚとを合わせて所定の共振周波数の帯域８９０～９６０ＭＨｚを得ることで、無線装置の送受信可能な帯域を広帯域化している。

【００６１】さらに、前記とは異なる所定の共振周波数の帯域、例えば１７１０～１８８０ＭＨｚに共振周波数が得られるように第１アンテナ素子１１の第２放射導体部１４の電気長と、第１アンテナ素子１１と導体地板１７との間隔を設定する。

【００６２】従って、第１アンテナ素子１１の所定の電気長の第１放射導体部１２による共振周波数の帯域８９０～９２５ＭＨｚと、第２アンテナ素子１８のこの電気長とは異なる電気長の放射導体部による共振周波数の帯域９２５～９６０ＭＨｚとを合わせた共振周波数の帯域８９０～９６０ＭＨｚと、これらの電気長とは異なる電気長の第２放射導体部１４による共振周波数の帯域１７１０～１８８０ＭＨｚの２つの送受信可能な帯域が無線装置には設定されている。

【００６３】そして、その後、これらの共振周波数に対応した最も感度良く送受信可能な無線装置本体の高周波回路部のインピーダンス、通常は約５０Ωに近づけるように、第２端子１６の位置を設定することによってアンテナのインピーダンスを決定している。

【００６４】しかし、アンテナ装置２９を無線装置本体に装着した場合、高周波回路部との配置によっては、アンテナ装置２９と高周波回路部の相対位置の違いに伴う電磁界分布の変化の影響を受け、インピーダンスが所定の値から変化し、共振周波数及びその帯域が変化して所望の感度が得られないことがある。

【００６５】従って、高周波回路部の配置が決定された後に、アンテナ装置２９を無線装置本体の所定位置に組み込み、インピーダンスが所定の値から変化している場合はこのインピーダンスを、第２アンテナ素子１８の開放端部１８Ａの切欠き部２８Ａ及び外周端部１８Ｂの切欠き部２８Ｂの面積を変えることで補正して、最も感度良く送受信可能なインピーダンスになるように構成されている。

【００６６】以上の構成において、アンテナ装置２９は、受信時には受信した所定の共振周波数の電磁波を電気信号に変換し、この電気信号を第２端子１６を通して無線装置本体の高周波回路部へ入力し、送信時には逆に高周波回路部からの所定の共振周波数の電気信号を電磁波に変換し、電磁波として放射するように構成されている。

【００６７】このように本実施の形態によれば、導体地板１７上に板状の第１アンテナ素子１１を設けると共に、第１アンテナ素子１１の近傍に所定の間隙を空けて板状の第２アンテナ素子１８を設けて、この第２アンテナ素子１８の開放端部１８Ａ及び外周端部１８Ｂと導体地板１７端部間に各々、切欠き部２８Ａ及び２８Ｂを設けることによって、共振周波数及びその帯域やインピーダンスを容易に補正できる、感度の良好なアンテナ装置を得ることができると共に、第１アンテナ素子１１の共振周波数の帯域と第２アンテナ素子１８の共振周波数の帯域とを合わせて無線装置の送受信可能な帯域を広帯域化したアンテナ装置を得ることができるものである。

【００６８】また、第１アンテナ素子１１又は第２アン

テナ素子１８の少なくとも一方を電気長の異なる複数の放射導体部で形成することによって、複数の帯域での送受信が可能なアンテナ装置を得ることができる。

【００６９】なお、以上の説明ではアンテナのインピーダンスを、第２アンテナ素子１８の開放端部１８Ａ及び外周端部１８Ｂの両方と導体地板１７間に、切欠き部２８Ａ及び２８Ｂを設けて補正するものとして説明したが、第２アンテナ素子１８の開放端部１８Ａ又は外周端部１８Ｂのどちらか一方と導体地板１７間に切欠き部を設けてインピーダンスを補正しても本発明の実施は可能である。

【００７０】或いは、第１アンテナ素子１１の第１放射導体部１２の開放端部１２Ａや外周端部１２Ｂ、又は第２放射導体部１４の開放端部１４Ａや外周端部１４Ｂと導体地板１７間に切欠き部を設けたり、第１アンテナ素子１１と第２アンテナ素子１８、第２アンテナ素子１８と導体地板１７の間にも切欠き部を設けてインピーダンスの補正を行っても良い。

【００７１】さらに、第１アンテナ素子１１や第２アンテナ素子１８、導体地板１７に切欠き部を設ける代りに孔を設けたり、第１アンテナ素子１１の開放端部１２Ａ，１４Ａや外周端部１２Ｂ，１４Ｂ或いは第２アンテナ素子１８の開放端部１８Ａや外周端部１８Ｂの端部とこれらと対向する導体地板１７の端部の上下相対位置を第１アンテナ素子１１又は第２アンテナ素子１８或いは導体地板１７を前後左右にずらすことでインピーダンスの補正を行っても良い。

【００７２】また、第１アンテナ素子１１に異なる所定の共振周波数の第２放射導体部１４を設けることで、２つの異なる無線装置の共振周波数の帯域で所定の感度が得られるものとして説明したが、第１アンテナ素子１１に第２放射導体部１４を設ける代りに、第２アンテナ素子１８に放射導体部を設けて、２つの異なる無線装置の共振周波数の帯域で送受信が可能なアンテナ装置が得られるようにしても良い。

【００７３】そして、第２アンテナ素子１８を第１アンテナ素子１１及び導体地板１７の間に配設されるようにしたが、第２アンテナ素子１８を第１アンテナ素子１１の上に配設したり、或いは第１アンテナ素子１１の側方に配設しても良い。

【００７４】さらに、切欠き部２８Ａや２８Ｂを第２アンテナ素子１８と導体地板１７の間に設ける他、第２アンテナ素子１８と第１アンテナ素子１１の間、或いはその両方に設けても良い。

【００７５】

【発明の効果】以上のように本発明によれば、インピーダンスの調整が容易で、感度の良好なアンテナ装置を得ることができるという有利な効果が得られる。

【図面の簡単な説明】

【図１】本発明の第１の実施の形態によるアンテナ装置の要部斜視図

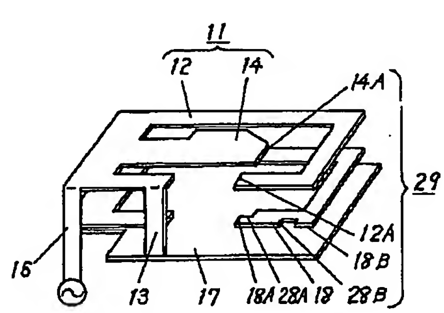
【図２】本発明の第２の実施の形態によるアンテナ装置の要部斜視図

【図３】従来のアンテナ装置の要部斜視図

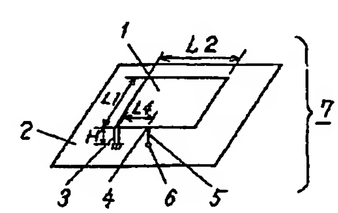
【符号の説明】

１１　第１アンテナ素子
１２　第１放射導体部
１２Ａ，１４Ａ，１８Ａ　開放端部
１２Ｂ，１４Ｂ，１８Ｂ　外周端部
１３　第１端子
１４　第２放射導体部
１６　第２端子
１７　導体地板
１８　第２アンテナ素子
１９，２９　アンテナ装置
２２Ａ，２２Ｂ，２８Ａ，２８Ｂ　切欠き部

【図２】

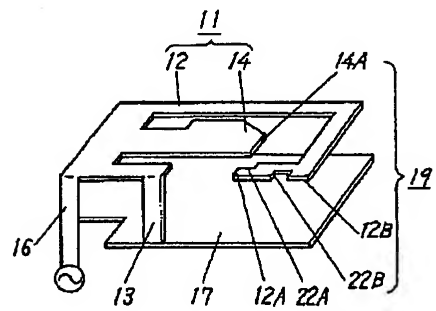


【図３】



【図１】

11 第１アンテナ素子
12 第１放射導体部
12A,14A 開放端部
12B 外周端部
13 第１端子
14 第２放射導体部
16 第２端子
17 導体地板
19 アンテナ装置
22A,22B 切欠き部



フロントページの続き

Ｆターム(参考)　5J045 AA01 AA03 AB05 DA09 GA04
HA02 JA11 NA03
5J046 AA03 AA07 AB13 PA04